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(54) HEAT SINK

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Heat sink for semiconductor cell - has number of fins projecting from body portion, defining fluid flow passages

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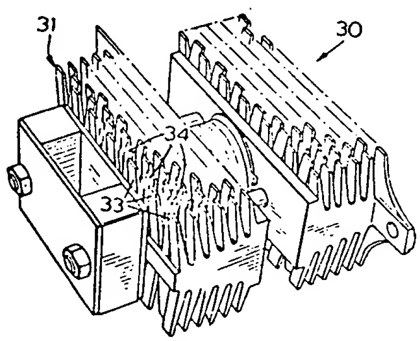
The heat sink for a semiconductor cell comprises a predetermined length cut transversely from an aluminium extrusion. The length of the extrusion has a body portion adapted for heat conducting contact with the semiconductor and a number of fins projecting from the body portion in spaced relation, defining fluid flow passages between fins.



The device, for transferring heat from the sink to the fluid, comprises slits across some or all of the fins, dividing these fins into fin segments. At least some of the fin segments are off setted into adjacent flow passages for increasing turbulence of fluid flow and fin surface, thereby increasing heat transfer from the sink to the fluid. 17. 3. 75. as 222307 (6pp932)

This invention relates to a heat sink for a semiconductor cell, and in particular to improved heat transfer from the sink to its cooling fluid.

Power semiconductor cells such as thyristors and diodes are frequently cooled through the medium of a heat sink and a cooling fluid such as air passed over the sink. The sink may consist of one or more short lengths of finned aluminum extrusion, and the assembly of cell and sink is frequently mounted inside a duct through which the fluid is passed. In flowing over the fins of the sink, the fluid takes up heat generated in the cell and carries it away to be dissipated.

The object of this invention is to improve sink to fluid heat transfer.

According to the invention, heat transfer is improved by increasing fin surface coming into contact with the fluid along with an increase in fluid turbulence. This is accomplished by slitting the fins crosswise and splaying some of the fin segments so formed into the fluid flow passages between fins. Preferably, the segments will be splayed alternately in opposite directions with respect to the original fin form.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a view in perspective of a prior art assembly of a semiconductor cell and a pair of heat sinks; and

Figure 2 is a view like Figure 1 showing the heat sinks modified according to the invention.

In the prior art assembly 10 shown in Figure 1, a semiconductor cell 11 is clamped between a pair of heat sinks 12 and 13 by means of a clamping structure 14. Sink 12 is an

integral structure of heat conducting material having a body portion 15 and two sets of fins 16 and 17 projecting from the body portion in opposite directions, and the fins are spaced apart so as to define fluid flow passages 18 between them. The body portion 15 of sink 12 has a wide face 19 which abuts a flat surface on one main electrode of cell 11. As clearly illustrated in Figure 1, sink 13 is like sink 12 except that it is turned about in the assembly so that the wide face 20 of its body portion abuts a flat surface on the other main electrode of the cell. Structure 14 clamps the cell firmly between the sinks so that the two electrodes of the cell are in good heat transfer relation with the sinks. A convenient way to make heat sinks such as 12 and 13 is to begin with an aluminum extrusion and cut sink lengths from the extrusion. Aluminum is readily extruded into shapes having a body portion such as 15 and fins such as 16 and 17 projecting from the body portion.

Heat generated in cell 11 by an electric current flowing in it is conducted to sinks 12 and 13, and from the sinks to a fluid such as air flowing over the sinks. Assembly 10 is intended to be mounted inside a duct through which cooling air passes, e.g., forced air flow. It will be mounted in the duct in such a way that the air comes into contact with the maximum sink surface, i.e., air flow along the passages 18 between fins.

Figure 2 shows assembly 10 modified according to the invention to improve heat transfer from the sinks to the cooling air. In this figure, assembly 30 has all the fins on the heat sinks 31 and 32 slit crosswise so that each fin now becomes a number of fin segments as indicated at 33 and 34 for fin 35. Slitting may be done with a gang saw; the many cuts

or slits cut across all the fins of a sink and extend from the tips of the fins to near their juncture with the body portion. After slitting, the segments formed thereby are splayed from the original fin form, preferably, alternately in opposite directions as indicated at 33 and 34 for fin 35. Offsetting the fin segments into the spaces between fins interrupts the uniform flow channels, causing the air to follow circuitous routes where it comes into contact with more heat transfer surface.

no sequent step

Test data have shown that the sink thermal resistance is indeed reduced by the slitting and splaying operation. For the same air-flow rate, the thermal resistance is reduced by 20 to 35% depending upon the degree of bending of the segments. This lower thermal resistance permits higher currents per cell and, for large power conversion equipment, therefore, the number of cells, the number of sinks and the number of auxiliary components can be significantly reduced. The cost of slitting and splaying the fins is relatively low compared to the potential cost reduction in the complete equipment.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A heat sink for a semiconductor cell, said heat sink comprising: a predetermined length cut transversely from an aluminum extrusion; said length of the extrusion having a body portion adapted for heat conducting contact with the semiconductor and a plurality of fins projecting from the body portion in spaced relation, defining fluid flow passages between fins; the improved means, for transferring heat from the sink to the fluid, comprising slits across some or all of said fins dividing these fins into fin segments; and offsets of at least some of said fin segments into adjacent flow passages for increasing turbulence of fluid flow and fin surface, thereby increasing heat transfer from the sink to the fluid.

2. The heat sink of claim 1 wherein the fin segments in each fin are offset alternately in opposite directions.

3. The heat sink of claim 1 wherein said body portion has at least one side from which the fins project, said slits extend across all of said fins, dividing each fin into fin segments, and said segments of each fin are splayed out alternately in opposite directions from the original fin form.

4. The heat sink of claim 3 wherein said body portion has two opposite sides provided with said splayed fin segments.

5. The combination of a semiconductor cell sandwiched between two of the heat sinks of claim 4.

6. The heat sink of claim 3 or 4 wherein the slits are saw cuts across the fins, extending from the tips thereof to near the roots thereof.

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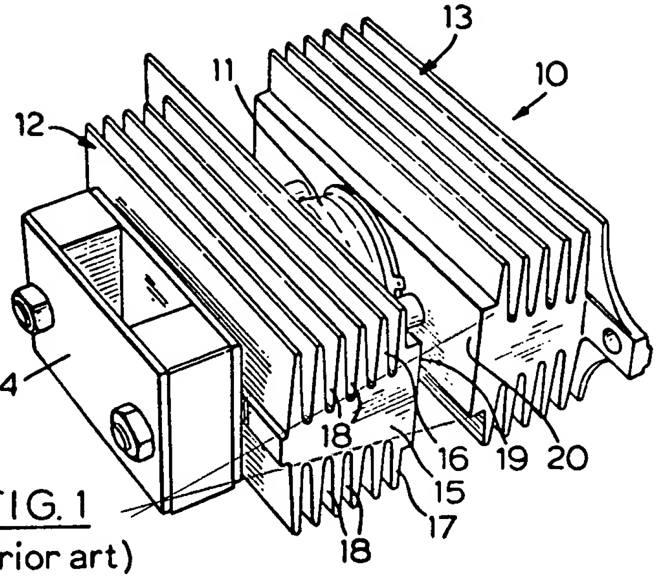

FIG. 1
(prior art)

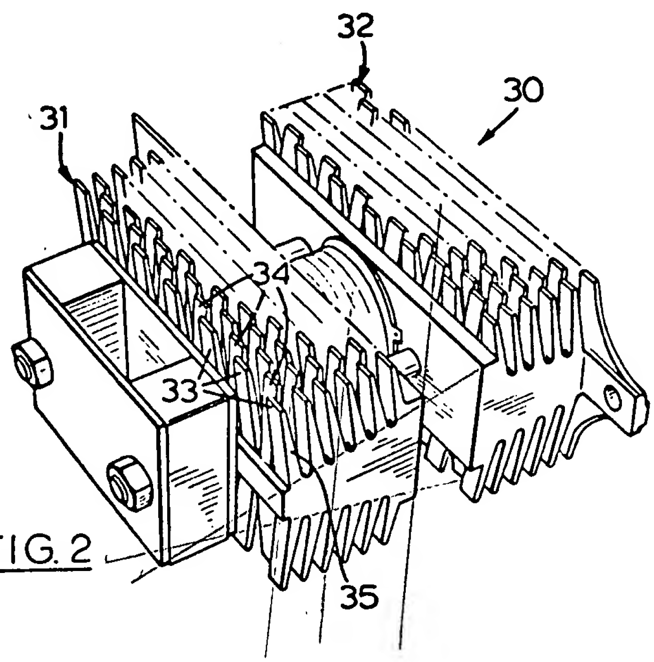

FIG. 2